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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/505,224	08/20/2004	Yoshinori Teshima	ASAIN0150	5393

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EXAMINER	
WASHBURN, DANIEL C	

ART UNIT	PAPER NUMBER
2628	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	01/24/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/505,224	TESHIMA ET AL.	
	Examiner	Art Unit	
	Dan Washburn	2628	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 20 August 2004.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-9 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-9 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 20 August 2004 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date 8/20/04, 12/8/06.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 101

35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

Claims 1-9 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.

Claims 1-9 read on an abstract idea, as initially defined in claims 1 and 8. For example, claim 1 describes a division step, a cutting point step, a boundary deciding step, a cell classification step, and a boundary cell data classification step, but claim 1 does not describe a tangible result of the process (e.g., displaying an isosurface that is formed as a result of the steps described in the claim). Therefore, the claims are directed solely at an abstract idea and do not produce a tangible result.

For claims including such excluded subject matter to be eligible, the claim must be for a practical application of the abstract idea, law of nature, or natural phenomenon. Diehr, 450 U.S. at 187, 209 USPQ at 8 ("application of a law of nature or mathematical formula to a known structure or process may well be deserving of patent protection."); Benson, 409 U.S. at 71, 175 USPQ at 676 (rejecting formula claim because it "has no substantial practical application").

To satisfy section 101 requirements, the claim must be for a practical application of the § 101 judicial exception, which can be identified in various ways:

- The claimed invention "transforms" an article or physical object to a different state or thing.

- The claimed invention otherwise produces a useful, concrete and tangible result.

Further, claim 8 describes a computer program, which is considered a data structure. Data structures not claimed as embodied in computer-readable media are descriptive material per se and are not statutory because they are not capable of causing a functional change in the computer. See, e.g. Warmerdam, 33 F.3d at 1361, 31 USPQ2d at 1760 (claim to a data structure per se held nonstatutory). Such claimed data structures do not define any structural and functional interrelationships between the data structure and other claimed aspects of the invention which permit the data structure's functionality to be realized. In contrast, a claimed computer-readable medium encoded with a data structure defines structural and functional interrelationships between the data structure and the computer software and hardware components which permit the data structure's functionality to be realized, and is thus statutory. The preamble of the claim should describe a computer readable medium encoded with a computer program, the computer program containing a set of instructions that when executed by a computer, cause the computer to carry out the method described by the body of the claim.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-3 and 8 are rejected under 35 U.S.C. 102(b) as being anticipated by non-patent literature "Constructing Isosurfaces from CT Data," by Ake Wallin (referred to herein as 'Wallin').

As to claims 1 and 8, Wallin describes a method and computer program for converting boundary data into cell inner shape data, characterized by comprising: a division step (A) of dividing external data constituted of the boundary data of an object into cells in an orthogonal grid (page 28 first paragraph and page 32 second column first paragraph describe that the present invention is able to input computed tomography (CT) data slices at 2 mm intervals in order to generate a 3D representation of the object currently being scanned. Page 29 second column third paragraph describes that the surface generation process consists of two phases: 1. Edge generation based on the isosurface and cube intersections, and 2. Edge connection and polygon generation. The process of inputting slices of CT data and processing two CT slices at a time in order to generate 3D data is considered a division step of dividing external data constituted of the boundary data of an object into cells in an orthogonal grid, where in this case each slice is divided up into a 2D orthogonal grid of cells and two adjacent slices are combined to create a 3D orthogonal grid of divided up cubic cells); a cutting

point deciding step (B) of deciding an intersection point of the boundary data and a cell edge as a cell edge cutting point (page 30 second column third paragraph describes that two CT slices are kept in memory at a time. In each step through the two slices, this method processes three faces of each cube. For each of the faces, it determines an edge configuration. With four voxels at the corner of the face, 16 cases occur (Figure 4). Processing faces of a cube in order to determine an edge configuration is considered a cutting point deciding step of deciding an intersection point of the boundary data and a cell edge as a cell edge cutting point); a boundary deciding step (C) of deciding a boundary formed by connecting the cell edge cutting points as the cell inner shape data (page 31 first column fourth (complete) paragraph through page 32 first column describes the polygon generation algorithm. For each surface to be generated, a LIFO stack of edges not yet processed is utilized. The method picks any edge off the stack and connects that edge with any valid edge either from the stack or from the edge hash table. Such a valid edge must be positioned within the same cube as the first edge picked. When the stack is empty, that particular surface is completed, and when the edge hash table is empty, all surfaces have been generated. The polygon generation algorithm is considered a boundary deciding step of deciding a boundary formed by connected the cell edge cutting points as the cell inner shape data); a cell classification step (D) of classifying the divided cells into a nonboundary cell including no boundary surfaces and a boundary cell including a boundary surface (page 30 second column third paragraph and page 31 first column first (complete) paragraph describe the edge generation algorithm. The edge generation algorithm is considered a

cutting point deciding step, as described above, and a cell classification step. The edge generation algorithm determines the edge configuration required for each face. In some cases the face is determined to contain a portion of the isosuface (cases 1 through 14), in one case the face is determined to be completely outside the isosurface (case 0), and in one case the face is determined to be inside the isosurface (case 15). Wallin describes that once the four neighboring voxels in a face have been determined, the program must determine which ones are outside and which ones are inside the surface. A simple thresholding scheme is used to determine the type of each voxel. If a voxel is below a user defined threshold value then it is outside the isosurface, and if it is above the user defined threshold value then is it inside the surface. Faces that are bordered by four voxels that are all determined to be inside or outside the isosurface are considered nonboundary cells, and faces that are bordered by four voxels where at least one voxel is inside the surface and at least one voxel is outside the surface are considered boundary cells. The edge generation algorithm classifies faces outside the isosurface as case 0 and faces inside the isosurface as case 15, while all other cases are classified as one of cases 1 through 14. Thus, the edge generation algorithm is considered a cell classification step that classifies the divided cell into a nonboundary cell (e.g., case 0 and case 15) including no boundary surface and a boundary cell (e.g., cases 1 through 14) including a boundary surface); and a boundary cell data classification step (E) of classifying cell data constituting the boundary cell into internal cell data inside the cell inner shape data and external cell data outside the cell inner shape data (page 30 second column fifth paragraph describes that when two

intersections occur on a face (see configurations 5 and 10 of Figure 4) the edge generation algorithm can use the interpolated value at the center of the face to determine if that point lies inside or outside the isosurface. Depending on the value of the center of the face, the generated surface may differ slightly. Namely, if the interpolated value at the center of the face is less than the user defined threshold value then the center of the face is not part of the isosurface and only the corners of the face are to be included in the rendered isosurface. On the other hand, if the interpolated value at the center of the face is equal to or greater than the user defined threshold value then the center of the face is part of the isosurface and only the center portion of the face should be included in the rendered isosurface. Determining the interpolated threshold value at the center of the cell in order to determine which portion(s) of the cell should be included in the isosurface is considered a boundary cell data classification step of classifying cell data constituting the boundary cell into internal cell data inside the cell inner shape data and external cell data outside the cell inner shape data).

Regarding claim 2, Wallin describes a method characterized in that: the cells are rectangular cells in two-dimensional representation (page 30 second column third paragraph and Figure 4 describe that 2D slices of CT data are used to generate a 3D image of a CT scan. The cells that make up each 2D image are considered rectangular cells in a two-dimensional representation), and in the cutting point deciding step (B), intersection points of boundary data and cell edges that have totally 16 arrangement cases are decided as the cell edge cutting points, and the arrangement cases that become equivalence classes by rotational operation are decided as identical patterns so

that the 16 arrangement cases are further classified into 6 patterns (page 30 second column third paragraph and Figure 4 describe the edge generation algorithm, which is considered the cutting point deciding step, as described in the rejection of claim 1. The cited section discloses that 16 cases of isosurface/face intersections occur, based on the four voxels that make up the corners of the face.. Further, these 16 cases can be classified into 6 patterns based on rotational operations: (1) case 0 is one pattern, (2) cases 1, 2, 4, and 8 are one pattern, (3) cases 3, 6, 9, and 12 are one pattern, (4) cases 5 and 10 are one pattern, (5) cases 7, 11, 13, and 14 are one pattern, and finally, (6) case 15 is one pattern. Each of the cases within a pattern can be rotated to represent the rest of the cases, and the 6 patterns represent the 16 arrangement cases illustrated in Figure 4).

Concerning claim 3, Wallin describes a method characterized in that: in the boundary deciding step (C), a boundary line made by connecting the cell edge cutting points is decided as the cell inner shape data for all the 6 patterns (page 30 second column third through sixth paragraphs and Figure 4 describe the process for determining the edge configuration for each four voxel face within a CT scan. When no intersections occur, the algorithm produces no edges, when one intersection occurs, the algorithm produces two edges, one directed in each direction, and when two intersections occur, the algorithm produces four edges, all directed in the appropriate directions. All edges are stored in memory so that a polygon surface can later be generated. Each boundary line that is formed (if one is formed) by a cell intersection encloses the cell inner shape data (the polygon that makes up the isosurface) for the

face; thus, each boundary line is considered a boundary line that defines the cell inner shape data. The boundary line creates the boundary or boundaries for all 16 arrangements illustrated in Figure 4 (where a boundary line is required); thus, the boundary line made by connecting the cell edge cutting points is decided as the cell inner shape data for the 6 equivalent patterns, as the 6 equivalent patterns are derived from the 16 cases illustrated in Figure 4 (see the rejection of claim 2 for further detail regarding the 6 equivalent patterns that are derived from the 16 cases illustrated in Figure 4)).

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The background of Salomie (US 6,982,710) describes the marching cubes algorithm and various alterations and improvements to the original marching cubes algorithm, Cline et al. (US 4,710,876, US 5,166,876, US 4,729,098, and US 4,719,585) describe the original marching cubes algorithm, and non patent literature "Hierarchical octree approximations for boundary representation-based geometric models," by Ajay Kela, describes using octree approximation algorithms to efficiently represent 3D objects.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dan Washburn whose telephone number is (571) 272-5551. The examiner can normally be reached on Monday through Friday 8:30 a.m. to 5:00 p.m..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ulka Chauhan can be reached on (571) 272-7782. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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1/19/07

Ulka Chauhan

ULKA CHAUHAN
SUPERVISORY PATENT EXAMINER